been made, but at the same time I do not suggest that there is no room for improvement of our system of training chemists. Progress in every department of industrial chemistry is ultimately dependent upon research, and therefore a sufficient supply of chemists with practical knowledge and experience of the methods of research is vital. This being so, it is an unfortunate thing that so many students are allowed to leave the universities in possession of a science degree but without any experience in investigation. The training of the chemist, so far as that training can be given in a teaching institution, must be regarded as incomplete unless it includes some research work, not, of course, because every student has the mental gifts which characterise the born investigator, but rather because of the inestimable value of the experience gained when he has to leave the beaten track and to place more dependence upon his own initiative and resource. Perhaps it is too much to expect that practice in research will be made an indispensable qualification for the ordinary degree; failing this, and indeed in every case, promising students should be encouraged, by the award of research scholarships, to continue their studies for a period of at least two years after taking the B.Sc. degree, and to devote that time to research work which would qualify for a higher degree.

On more than one occasion I have expressed the opinion that every chemist who looks forward to an industrial post should receive in the course of his training a certain amount of instruction in chemical engineering, by means of lectures and also of practical work in laboratories fitted out for the purpose. The practicability of this has been proved in more than one teaching institution, and experience has convinced me that chemists who have had such a course are generally more valuable in a works—whether their ultimate destination is the industrial research laboratory or the control of manufacturing operations—than those who have not had their studies directed beyond the traditional boundaries of pure chemistry. A course in chemical engineering, preferably preceded by a short course in general engineering and drawing, must, however, be introduced as *a supplement to*, and not as *a substitute for*, any part of the necessary work in pure chemistry, and consequently the period of undergraduate study will be lengthened if such a course is included; this is no disadvantage, but quite the contrary. I am glad to say that the University of Glasgow has recently instituted a degree in applied chemistry, for which the curriculum includes chemical engineering in addition to the usual courses in chemistry, and I hope that a place will be found for this subject by other universities.

NOTES.

THE King in Council has appointed Mr. Arthur Henderson, M.P., a member of the Committee of the Privy Council for the organisation and development of scientific and industrial research. The other non-official members of the Committee are Lord Haldane, the Right Hon. A. H. D. Acland, and the Right Hon. J. A. Pease, M.P. Mr. Henderson was the President of the Board of Education when the Government's research scheme was published in July of last year. As such he was a member of the Committee, which includes also, as official members, the Lord President of the Privy Council, the Chancellor of the Exchequer, the Secretary for Scotland, the President of the Board of Trade, and the Chief Secretary for Ireland.

By permission of the president and council of the Royal Academy an Exhibition of Arts and Crafts is to be held in the galleries of the Royal Academy from October 2 until the end of November next. The exhibition is being arranged by the Arts and Crafts Exhibition Society.

WE are informed that the Secretary of State for India has sanctioned the creation of a post of Director of Fisheries, Bengal, Bihar, and Orissa, and has further sanctioned the permanent appointment of the present Deputy Director of Fisheries (Mr. T. Southwell) to the post. A new Deputy Director will be appointed after the war.

THE death is announced, at sixty-eight years of age, of Sir James Sivewright, K.C.M.G., general manager of the South African Telegraphs, 1877–85, and Commissioner of Crown Lands and Public Works, Cape Colony, 1890–92, when he promoted considerable developments of the railway and telegraphic systems.

OXFORD has lately become poorer by the loss of two of her best-known sons, each in his own way distinguished as well outside the University as within it. During a long residence in Oxford Mr. R. W. Doyne, formerly Margaret Ogilvie reader in ophthalmology, whose career and work were referred to last week (p. 18), had won the respect and affection of colleagues and pupils alike. Dr. Edward Moore, as a young man, had one of the most distinguished academic careers on record. The chief efforts of his mature life were directed towards the welfare and independence of St. Edmund Hall, one of the most interesting of the ancient institutions of Oxford. Consistently conservative in his attitude towards academic questions, there was yet no trace of bigotry or bitterness in his opposition to changes which he thought ill-considered or dangerous. His death at the age of eighty-one removes one whose personal qualities endeared him to an unusually wide circle.

BY the death, on August 28, of Mr. George Coffey, Ireland has lost her foremost student of prehistoric archæology. The Neolithic and Bronze periods are represented in Ireland by a very fine series of monument, weapons, and other remains, and Mr. Coffey made these his special study, applying to them, almost for the first time, the knowledge gained by his French and Scandinavian colleagues from the important series of remains which have been brought to light during recent years in western Europe. He devoted special attention to the history of primitive art in Ireland, and by tracing the development of ornament and applying it to the monuments and other early remains of that country, he did much to establish the sequence of Irish prehistoric history. More recent periods also claimed his attention, and in his "Guide to the Celtic Antiquities of the Christian Period" preserved in the Royal Irish Academy collection in the Dublin National Museum (where for many years he was keeper of the Irish antiquities), he gave a scholarly account of the beautiful work of early historic times in Ireland.

THE death of Dr. C. T. Clough, of H.M. Geological Survey, by an accident on the railway near Bo'ness, has brought to a close a career of remarkable devotion to geological work. On Wednesday, August 23, Dr. Clough was examining rock exposures in the Bo'ness coalfield, and had occasion to cross the railway. He failed to clear an approaching train and was run over. Receiving immediate attention from the railway staff, he was sent by special train to Edinburgh, where an operation was performed. For a time he seemed to recover strength, but early on Sunday, August 27, he died in Edinburgh Infirmary. Dr. Clough was educated at Rugby and St. John's College, Cambridge, and joined the Geological Survey about forty years ago. His first work was done in the north of England; he was afterwards transferred to Scotland, and at the time of his death was senior District Geologist on the Scottish branch of the Geological Survey. Field work in difficult country had an especial attraction for him, and the minuteness and accuracy of his mapping on the six-inch scale were really astonishing. For many years most of his time was spent in the Highlands, in Cowal, the Loch Maree district, western Sutherlandshire, Glenelg, Strathcarron, and Glen Etive. He also surveyed Soay and part of Skye, and for the last ten years he had been in charge of the survey's work in Mull. Since 1901 Dr. Clough spent part of each year in the revision of the maps of the Scottish coalfields, and at first in the Lothian coalfield, later in the Wishaw, Holytown, and Bo'ness coalfields, he produced maps of unrivalled detail and completeness. Of late years he was in charge of the revision of the North Ayrshire field, and himself mapped the Kilmarnock district. A man of singular gentleness, patience, and modesty, Dr. Clough was beloved by all with whom he came in contact. Most of his contributions to geology have been published in survey memoirs. The Geological Society in 1906 awarded him the Murchison medal. In July of the present year the University of St. Andrews conferred on him the honorary degree of LL.D. He was a past-president of the Edinburgh Geological Society.

MANY readers of NATURE will have read with regret of the death, at the age of 62, of Mr. F. W. Frankland on July 23, at New York. Mr. Frankland was the eldest son of the late Sir Edward Frankland, K.C.B., F.R.S.; his brilliant career as a student at University College, London, was cut short by a breakdown in health in consequence of which he was recommended to proceed to New Zealand in 1875. On recovery he turned his great mathematical talents to account by entering the newly created Government Insurance Department of that colony, ultimately becoming Government Insurance Commissioner and Government Actuary and Statist and Registrar of Friendly Societies of New Zealand. He represented New Zealand as statistical delegate at the International Congress of Hygiene and Demography held in London in 1891. At University College, Frankland was one of the late Prof. W. K. Clifford's most distinguished students, and enjoyed a close intellectual intimacy both with him and with Herbert Spencer, and although the academic career for which he was so eminently fitted had been rendered impossible by his ill-health, he continued throughout life zealously to pursue his mathematical and philosophical studies and speculations. Already as a student in 1870 he had, independently of Clifford, arrived at that theory, or doctrine, of existence known as "mind-stuff," a paper on which he communicated to the Wellington (N.Z.) Philosophical Society in 1879; another paper, entitled "On the Metaphysic of Space," was communicated to the now defunct Philosophical Society of London, of which he became a member in 1885. He later evolved a theory of time in which he contended that time, like all else, has existence only in minds, and that the time-process is the dialectical concatenation of a series of "atomic *nows*" in the universe of awareness. In his mathematical speculations he was more especially drawn into the transcendental geometry of Lobatchewsky and Riemann, and in this domain he contributed papers "On the Simplest Continuous Manifoldness of Two Dimensions and of Finite Extent" to the London Mathematical Society (vol. viii., No. 107), and on the "Theory of Discrete Manifolds" to the American Mathematical Society in 1897. Always alive to the possibility of the scientific expansion and improvement in life insurance methods, Frankland originated and introduced in New Zealand the regulation that in the registration of the deaths of males the particulars of the family left should also be recorded, and the data so obtained have been found of great value by actuaries at home and elsewhere. His original views on a great variety of subjects are briefly outlined in "Thoughts on Ultimate Problems," published by David Nutt.

WE notice with regret the report from the Christiania correspondent of the *Morning Post* that Prof. H. Mohn, the well-known meteorologist, died on September 12, at eighty years of age.

THE death is announced, in his seventy-fourth year, of Mr. G. A. Hill, who was a tutor in chemistry at Harvard from 1865 to 1871, and assistant-professor of physics from 1871 to 1876. From 1898 to 1914 he was director of the Nolan laboratory for college preparation in physics and chemistry. He was the author, and joint author, of several text-books in mathematics and physics.

MR. LANSING, the American Secretary of State, has formally announced the signature of a Treaty with Great Britain for the protection of migratory birds. It will apply mainly to the migration of game and insect-eating birds from the United States to Canada. This is the first Treaty of the kind into which the American Government has entered.

NEWS has been received in America of the death of Mr. W. S. Lyon, the leading authority on botany and horticulture in the Philippine Islands, where he had been living since 1902. He had previously served as head of the California State Board of Forestry, and while holding this position had made, at the request of Prof. Asa Gray, a complete and valuable collection of the flora of the Catalina Islands.

MR. R. F. GRIGGS, who has been making an expedition to the Katmai volcano in the interests of the American Geographic Society, has returned to Kodiak, Alaska, and reports that its main crater is one of the largest in the world. It is miles across, and extends down thousands of feet to a blue-green lake, shimmering and sputtering at the bottom. The most wonderful of all sights at the crater was a place where a glacier, blown in two by the great eruption in June, 1912, still formed part of the crater wall, the intense heat being insufficient to melt this palisade of ice. Part of the crater wall is composed of igneous rock of brilliant colour.

SIX members of the Stefansson Arctic Expedition, under the leadership of Dr. Rudolph Anderson, have arrived at Nome, all of them in good physical condition. They reported that Stefansson himself is remaining in the Arctic to continue his exploration of the land he has discovered north of Prince Patrick Land, and that he is not likely to return during the present season. He left Dr. Anderson's party to the south of these lands that they might explore more thoroughly the Canadian continental line. They have mapped the coast-line from the Cape Parry Peninsula for a considerable distance east, and have made topographical and geological surveys of a huge region which lies half-way between northern Alaska and the outlet of Hudson Bay. Sir John Franklin's charts have been corrected, large copper fields have been discovered, and ethnological and other scientific information has been obtained.

ABOUT forty years ago a series of primitive mining implements was discovered in the old copper mines at Alderley Edge, Cheshire, which excited great interest. They were described by Prof. Boyd Dawkins in vol. v. (1876) of the Journal of the Anthropological Institute, who divided them into three classes:—(1) Hammers with a simple groove round the middle for the retention of the withy which formed the handle; (2) tools which, besides this groove, had one of their ends also grooved for the reception of a second withy, and thus were prevented from slipping when a blow was struck; (3) two implements which seemed to be wedges. Prof. Boyd Dawkins was inclined to believe that they were of pre-Roman age. Further examples of the same type were discovered a few years ago by Mr. F. S. Graves, who has contributed three specimens to the Hull Museum. They are made of glacier-borne erratics of igneous rock, carefully trimmed into shape. These interesting survivals of early mining are illustrated and described in No. 108 of the Hull Museum Publications.

ROCKY MOUNTAIN spotted fever is a typhus-fever-like disease occurring in limited areas in North America. So far no micro-organism has been definitely found associated with it. Wolbach now describes a bacterium having certain peculiar characters, which may be found in large numbers in the lesions characteristic of spotted fever in experimental animals. It is well stained with Giemsa's stain, which is not usual with bacteria, possesses low specific gravity, as it is not thrown down by centrifuging, and cannot be cultivated (*Journ. Med. Research,* xxxiv., 1916, p. 121).

THE subject of the filterability of micro-organisms through a porcelain filter is one of considerable interest and importance. The pores of such a filter are so fine that particles passing through them are usually beyond the limit of microscopic vision, and the viruses of several diseases are known to be of this nature. The possibility of easily visible micro-organisms having a sub-microscopic filterable stage has also to be considered. Wolbach shows that certain spiral organisms larger than many bacteria, viz. *Spirochaeta duttoni* of African tick fever, *Sp. clusa,* and *Sp. biflexa,* will pass through the pores of Berkefeld V, N, and W filters (*Amer. Journ. Tropical Diseases and Prevent. Med.,* ii., February, 1915, p. 494). On the other hand, trypanosomes from cultures and from animal tissues are not filterable through bacteria-proof filters (Wolbach, Chapman, and Stevens, *Journ. Med. Research,* xxxiii., 1915, p. 107).

THE fourteenth annual report of the Imperial Cancer Research Fund recently issued gives evidence of the effects of war-time conditions on the investigations. In spite of the depleted staff the essential organisation is being maintained, and a number of papers were published by the director and assistants. The studies of Dr. Tsurumi on heterologous tumour immunity constitute an attempt at biochemical analysis of new growths by testing the reactions to blood and tissue extracts of the sera of rabbits immunised against mouse and rat tumours. The hæmolytic and agglutinating properties were found to correspond to the specific protein reactions of mouse and rat tissues. Complement fixation gave indications of common properties in tumours of like histological types. A preliminary account was published of an interesting guinea-pig tumour, a lipo-sarcoma. The relation of the mitochondria to the development of fat in the cells of this growth showed that this process is to be regarded as a differentiation, and not as a fatty degeneration such as is common in the majority of rapidly growing neoplasms. Brief reference is made to unpublished work by the director on the relation of the anti-ferment power of the blood, to the phenomena of the Abderhalden reaction, and to an investigation by Dr. Cramer of the relation of the water content of transplantable carcinomata to rate of growth and other biological characters.

DR. F. H. EDGEWORTH publishes in the July issue of the *Quarterly Journal of Microscopical Science* results of his studies on the development and morphology of the pharyngeal, laryngeal, and hypobranchial muscles of mammals. The paper is a continuation of one published in that journal during 1914. The author is to be congratulated on the completion of his task, which must have entailed an enormous amount of labour.

THE Transactions of the Royal Scottish Arboricultural Society for July, 1916, contain an article by James W. Munro on the insects attacking the common pine in Scotland. Their life-history, which he has studied for some years, is traced in connection with the mode of felling of the timber, which leaves the felled area covered with branches and stumps. Mr. D. E. Hutchins records as a sign of progress the recent appointment of Mr. Lane Poole, a competent forester trained at Nancy, as chief forest officer in Western Australia. This post had been left vacant for twelve years, though the forests of this State are of great value, consisting mainly of karri and jarrah, two of the finest species of Eucalyptus.

IN *British Birds* for August Mr. J. H. Owen continues his notes on the breeding habits of the sparrow-hawk. He describes now the behaviour of the male, which, it would seem, takes no part in the incubation of the eggs, though he feeds the female during both the laying and incubating periods. The food he brings her is never eaten at the nest, but on some tree at a little distance therefrom, to which she flies when called by her mate. Sometimes the transference of food takes place in mid-air, but as a rule it is brought to the tree. As the date of hatching approaches she shows less and less inclination to leave the nest, so that the last days of incubation are passed fasting. The male never feeds the young, so that if the female is killed these must starve. He will bring food and leave it at the nest, but lacks the instinct to break up and distribute it among his offspring. The young, it would seem, are quite unable to feed themselves until they are three weeks old.

AN interesting series of papers on muscle physiology appeared in the May number of the *American Journal of Physiology* by Prof. Frederic S. Lee and his colleagues at Columbia University, New York. In the first place, it is shown that the diaphragm takes the leading position among the skeletal muscles, as regards its power of work, and its efficiency is correlated with its richness in glycogen. The effects of temperature and humidity were also examined in cats' muscles. The cats were arranged in three series: (*a*) after exposure for six hours to 21° C. and 52 per cent. humidity; (*b*) 24° C. and 70 per cent. humidity; and (*c*) 33° C. and 90 per cent. humidity. The muscles were excised, stimulated to exhaustion, and the total work measured. The following percentages express the duration of the working period: (*a*) 100, (*b*) 97, and (*c*) 89; and the total work was (*a*) 110, (*b*) 85, (*c*) 76. The total blood per kilogram of body-weight was decreased in the cats exposed to the higher temperatures and humidity, and their blood-sugar was reduced in quantity. We have here an objective illustration of the enfeebling effects of hot, moist climates, which are familiar as subjective experiences.

THE *Bul. Imp. Acad. Sci.* (Petrograd, March, 1915) contains an article by A. A. Richter and E. M.

Kollegorsky describing a series of experiments on the mechanism of photosynthesis by means of a luminescent bacterium (*Photobacterium italicum*). Taking as the subject of their experiments two plants of strongly contrasted habits, *Aspidistra elatior* and *Bambusa verticillata*, they give the following summary of the results of their researches:—(1) The working out of a new method of the quantitative study of photosynthesis by the aid of luminescent bacteria. (2) It is established that the luminous intensity indispensable for the decomposition of carbonic acid is the same for plants which vary ecologically. (3) It is shown that the luminous intensity effecting the liberation of oxygen in photosynthesis may be in the case of plants possessing special light-collecting apparatus much lower than for those not so provided.

MUCH valuable meteorological and magnetical work is being done at Hongkong, and the report of the director, Mr. T. F. Claxton, has just reached this country. Continuous photographic records are being maintained showing the variations of barometric pressure and temperature, and there are daily automatic records of the direction and velocity of the wind, the amount of rain, duration of sunshine, and the relative humidity of the air. Eye observations of many of the elements are also made each hour. Attention is directed to the defect of wind velocity which has been noticed for several years past, and this has hitherto been attributed to instrumental rather than climatic causes. The decrease has occurred more or less steadily from 1884 to 1915. A similar defect in the wind velocity has been noticed at the Royal Alfred Observatory, Mauritius. The director of the Mauritius Observatory, in a recent report, remarks: "There is now reason to believe that the low velocities during the years 1901–11 are almost entirely climatic, and due probably to a periodic oscillation in this element." At Hongkong the decrease in the mean velocity of the wind is said to be far greater than the secular variations in any other element, and must, in the opinion of the director, at least in part, be attributed to instrumental causes.

THE Journal of the Franklin Institute for August contains a paper by Prof. Kennelly and Messrs. Achard and Dana, of the Massachusetts Institute of Technology, dealing with the increase of the resistance of standard forms of track and contact rails when the current through them is an alternating instead of a direct one. The currents used were sinusoidal of frequencies from 25 to 60 per second, and varied in root mean square values from 10 to 800 amperes. Both the alternating potentiometer method of comparing voltages down the rail and a manganin strip in series, and the dynamometer method of measuring the current and the active and reactive components of the voltage down the rail, were found satisfactory. The ratio of the resistances with alternating and direct currents increased with the magnitude of the currents to a maximum, at which it remained in most cases, but in a few cases it diminished again. The ratio, when a maximum, had values about 7 for track and 12 for contact rails at a frequency 25, and varied nearly as the square foot of the frequency. The best form of rail is discussed, and it is shown that theory reproduces the observations with a fair degree of accuracy.

WE have received from Mr. Oertling a copy of his recently issued catalogue of balances and weights. This firm claims that all its balances, etc., are, and always have been, manufactured in London. On comparison of the present list with that issued in 1909, we notice that with few exceptions all the balances listed seven years ago appear in the new catalogue; the prices, however, have increased in a proportion varying from 19 to 26 per cent., presumably owing to the general increase in cost of commodities and labour due to the war. Several balances designed especially for the Royal Arsenal, Woolwich, the Aircraft Factory, the Admiralty, and for explosives factories now appear for the first time. One of these is specially adapted for rapidity of weighing. Except in one item the weights are listed precisely as in the 1909 catalogue. The exception is that a cheap set has been introduced for school use. The increase in price of the sets of weights is not so large, varying from 11 to 20 per cent., except in one instance.

WE learn from the *Engineer* of September 1 that the Reclamation Service of the United States has recently finished at Elephant Butte, about twelve miles west of Engle, the dam which forms the keystone of its great water storage project in New Mexico. The work, which has been under construction since 1911, is designed with the object of providing water for irrigational purposes, by means of the storage of the flood waters of the Rio Grande, which are to be distributed at various points downstream, so that a total area of 185,000 acres will be brought under treatment. The district has a general elevation of 3700 ft. above sea-level; the climate is mild, and the temperature fairly equable throughout the year; the annual rainfall is about 10 in. It is thus a suitable location for husbandry, if the soil be adequately watered. The lake, or reservoir, which has been formed by damming the cañon of the Rio Grande at Elephant Butte, has, when full, a storage capacity of 862,200 million gallons, a surface area of 42,000 acres, a maximum length of 45 miles, a maximum depth of 193 ft. (the average is one-third of this), and a shore line of something above 200 miles. The dam contains 610,000 cubic yards of masonry, estimated to weigh about a million tons. It is not quite so imposing a structure as the two earlier dams built by the same service, but it is nevertheless a notable engineering achievement, and the outlay of about 1,000,000*l.* on the scheme will probably be considered but a moderate price to pay for the benefits which are expected to be derived from the undertaking.

MR. A. T. HOPWOOD writes to say that the display of aurora described by Mr. Denning in NATURE of August 3, was visible in Manchester about 11 p.m. (Summer Time) on the night of August 26.

ECONOMIC pamphlets on "The House-Fly as a Danger to Health," "The Louse and its Relation to Disease," and "Fleas as a Menace to Man and Domestic Animals," have already been published by the British Museum (Natural History), South Kensington. Three further pamphlets on, respectively, "Mosquitoes in Relation to Disease," "The Bed-Bug and its Relation to Disease," and "Ticks, etc., Injurious to Man," are in preparation.

OUR ASTRONOMICAL COLUMN.

MEASUREMENT OF CLOSE SOLAR LINES.—As a preliminary to the determination of the wave-lengths of solar lines in international units, and in connection with the search for mutual influence between neighbouring lines, Dr. C. E. St. John and Miss Ware have made a careful study of the difficulties attending the precise measurement of closely adjacent lines (*Astrophysical Journal*, xliv., p. 15). Micrometric measurements were made by at least two observers upon a series of spectrograms representing the first five orders of